FUEL CELL AND CONTROL METHOD THEREFOR

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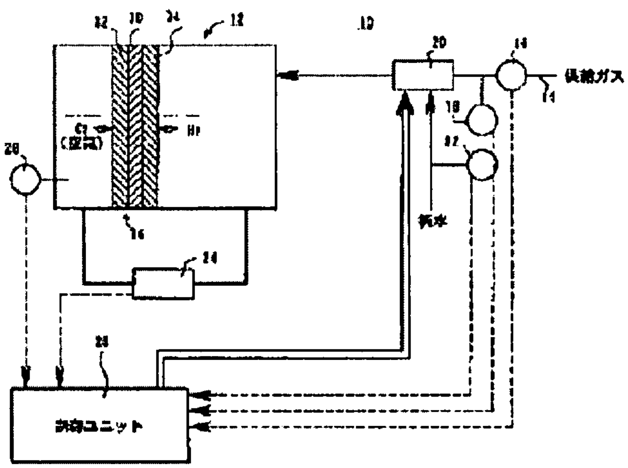
Abstract of **JP10255828**

PROBLEM TO BE SOLVED: To maintain supply gas in an optimal humidifying condition, and prevent the deterioration of fuel cell performance by controlling a pure water injecting means on the basis of signals from a supply gas flow rate detecting means, a supply gas temperature detecting means, a pure water temperature detecting means, a fuel cell load detecting means and a fuel cell internal temperature detecting means. SOLUTION: A gas flow rate correction value is read in on the basis of a supply gas flow rate detected through a supply gas flow rate detecting means 16, and a basic pure water injection quantity is set in response to the gas flow rate correction value. An operation is performed on an actual pure water injection quantity by multiplying the basic pure water injection quantity by a gas temperature correction value, a fuel cell temperature correction value and a fuel cell load correction value. Pure water set to a pure water injection quantity is injected into supply gas in a gas supply passage 14 from a pure water injecting means 20, and it is humidified. Therefore, a humidifying quantity according to an operating condition of a fuel cell main body 12 is controlled by adding a flow rate and a temperature of the supply gas, and optimal fuel cell output is obtained from the fuel cell main body 12, and drying of an electrolyte film by lack of humidification can be avoided.



JAPANESE [JP,10-255828,A]

[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1] The body of a fuel cell incorporating the fuel cell structure by which the anode lateral electrode and the cathode lateral electrode were opposite-**(ed) on both sides of the electrolyte membrane, The distributed gas flow rate detection means for detecting the flow rate of said distributed gas which flows the gas supply path and said gas supply path for sending distributed gas to said body of a fuel cell, The pure-water injection means for supplying pure water to said distributed gas which flows said gas supply path, The pure-water temperature detection means for detecting the temperature of said pure water supplied to said pure-water injection means, The cell load detection means for detecting the cell load of said body of a fuel cell, The interior temperature detection means of a cell for detecting the temperature within said body of a fuel cell, The fuel cell characterized by having a control means for controlling said pure-water injection means based on the signal from said distributed gas flow rate detection means, said pure-water temperature detection means, said cell load detection means, and said interior temperature detection means of a cell.
[Claim 2] It is the fuel cell characterized by having a distributed gas temperature detection means for detecting the temperature of said distributed gas which flows said gas supply path in a fuel cell according to claim 1, and for said control means adding the signal from said distributed gas temperature detection means, and controlling said pure-water injection means.
[Claim 3] The process which detects the flow rate of the distributed gas sent to the body of a fuel cell incorporating the fuel cell structure by which the anode lateral electrode and the cathode lateral electrode were opposite-**(ed) on both sides of the electrolyte membrane through a gas supply path, The process which detects the temperature of the pure water injected by said distributed gas which flows said gas supply path, The process which detects the cell load of said body of a fuel cell, and the process which detects the temperature within said body of a fuel cell, The control approach of the fuel cell characterized by having the process which controls said pure-water injection means based on the flow rate of said detected distributed gas, the temperature of pure water, a cell load, and the interior temperature of a cell.
[Claim 4] In the control approach according to claim 3, while reading quantity-of-gas-flow correction value based on the flow rate of said said detected distributed

gas The process which reads the basic pure-water injection quantity corresponding to said quantity-of-gas-flow correction value, and the process which reads a pure-water temperature compensation value, cell load correction value, and the interior temperature compensation value of a cell based on the temperature of said detected pure water, a cell load, and the interior temperature of a cell, The control approach of the fuel cell characterized by having the process which calculates the pure-water injection quantity injected by said distributed gas based on said basic pure-water injection quantity, said pure-water temperature compensation value, said cell load correction value, and said interior temperature compensation value of a cell.

[Claim 5] The control approach of the fuel cell characterized by adding said gas-temperature correction value and calculating said pure-water injection quantity while detecting the temperature of said distributed gas which flows said gas supply path in the control approach according to claim 4 and reading gas-temperature correction value based on the temperature of said said detected distributed gas.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the fuel cell which supplies the distributed gas humidified in the body of a fuel cell, and its control approach.
[0002]
[Description of the Prior Art] For example, the fuel cell constituted by pinching and carrying out two or more laminatings of the fuel cell structure which opposite-** (ed) the anode lateral electrode and the cathode lateral electrode on both sides of the solid-state polyelectrolyte film with a separator is developed, and it is being put in practical use by various applications.
[0003] By supplying oxidant gas (air) to a cathode lateral electrode, said hydrogen gas ionizes this kind of fuel cell, and it flows the inside of the solid-state polyelectrolyte film, and it is constituted so that electrical energy may be obtained outside by this, while supplying hydrogen gas (fuel gas) to an anode lateral electrode.
[0004] In this case, in the above-mentioned fuel cell, in order to demonstrate an effective generation-of-electrical-energy function, it is necessary to maintain the solid-state polyelectrolyte film in the desired humidification condition. For this reason, the distributed gas humidification equipment which humidifying the distributed gas which is hydrogen gas and oxidant gas is performed, for example, is indicated by JP,7-263010,A is known.
[0005] With the above-mentioned conventional technique, the signal from a load detection means to detect the load of a fuel cell is received. While supplying the amount of the pure water corresponding to the demand moisture content of this fuel cell to the gas supply path which sends distributed gas to said fuel cell In response to the signal from a temperature detection means to detect the internal temperature of said fuel cell, it is constituted so that a heating means formed in said pure-water supply path so that it might become by which the temperature of said pure water spreads the internal temperature of this fuel cell, abbreviation, etc. may be controlled. That is, the load and internal temperature of a fuel cell are detected, and the amount and temperature of pure water which are supplied to a gas supply path are controlled by the above-mentioned conventional technique.
[0006]
[Problem(s) to be Solved by the Invention] However, with the above-mentioned

conventional technique, in order to adjust the humidification condition of distributed gas based on the load and internal temperature of a fuel cell, it is easy to generate response delay in time. Thereby, there are a possibility that the optimal amount of humidification cannot be secured in a transition stage, and a desired cell output cannot be obtained, a possibility that the amount of humidification may be insufficient and an electrolyte membrane may dry, etc., especially. That is, although the flow rate of distributed gas increased, if the amount of the pure water injected by this distributed gas is not changed, the optimal amount of humidification cannot be obtained but the problem that an electrolyte membrane dries and a cell output declines sharply is pointed out.
[0007] This invention can solve this kind of problem, can humidify distributed gas the optimal according to the operating state of a fuel cell, and aims at offering the fuel cell which can obtain a desired cell output certainly, and its control approach.
[0008]
[Means for Solving the Problem] In order to solve the aforementioned technical problem, based on the detecting signal from a distributed gas flow rate detection means, a pure-water temperature detection means, a cell load detection means, and the interior temperature detection means of a cell, the humidification condition of the distributed gas supplied to the body of a fuel cell is controlled by the fuel cell concerning this invention, and its control approach by controlling a pure-water injection means. Therefore, time response delay etc. is not caused and optimal distributed gas humidification control according to the actuation situation of a fuel cell is performed. Thereby, the fall of the cell output by the lack of the amount of humidification and desiccation of an electrolyte membrane can be prevented as much as possible, and it becomes possible to always obtain an effective cell output.
[0009] Furthermore, the detecting signal from a distributed gas temperature detection means is added, and a pure-water injection means is controlled. For this reason, while preventing generating of dew condensation in a gas supply path, when distributed gas temperature becomes high, the fall of the cell output by the lack of the amount of humidification of this distributed gas is not caused.
[0010]
[Embodiment of the Invention] Drawing 1 shows the outline block diagram of the fuel cell 10 concerning the 1st operation gestalt of this invention.
[0011] The gas supply path 14 where a fuel cell 10 sends distributed gas (fuel gas/oxidant gas) to the body 12 of a fuel cell, and this body 12 of a fuel cell, A distributed gas flow rate detection means 16 to detect the flow rate of the distributed gas which flows this gas supply path 14, A distributed gas temperature detection means 18 to detect the temperature of said distributed gas which flows said gas supply path 14, A pure-water injection means 20 to supply pure water to said distributed gas which flows said gas supply path 14, A pure-water temperature detection means 22 to detect the temperature of said pure water supplied to this pure-water injection means 20, It has a cell load detection means 24 to detect the cell load of said body 12 of a fuel cell, an interior temperature detection means 26 of a cell to detect the temperature within said body 12 of a fuel cell, and the control unit (control means) 28 that carries out drive control of said fuel cell 10.

[0012] A control unit 28 consists of microcomputers equipped with CPU, ROM, and RAM, and has the function which controls the pure-water injection means 20 based on the signal from the distributed gas flow rate detection means 16, the distributed gas temperature detection means 18, the pure-water temperature detection means 22, the cell load detection means 24, and the interior temperature detection means 26 of a cell.
[0013] The body 12 of a fuel cell is equipped with the fuel cell structure 36 which opposite-**(ed) the air pole (cathode lateral electrode) 32 and the hydrogen pole (anode lateral electrode) 34 on both sides of the solid-state polyelectrolyte film 30. The body 12 of a fuel cell is constituted by carrying out two or more laminatings of this fuel cell structure 36 through the separator which is not illustrated.
[0014] Thus, actuation of the fuel cell 10 constituted is explained below in connection with the control approach concerning this invention.
[0015] First, it is in the inclination for the amount of humidification of the electrolyte membrane 30 which constitutes the body 12 of a fuel cell to decrease as the relation between the flow rate of distributed gas and the amount of humidification is shown in drawing 2 A and the flow rate of distributed gas increases. For this reason, as shown in drawing 2 B, the relation between the flow rate of distributed gas and the pure-water injection quantity is set up.
[0016] On the other hand, as shown in drawing 3 , the amendment table of the quantity-of-gas-flow correction value corresponding to change of a distributed gas flow rate is set up beforehand. As other amendment tables, the distributed gas temperature compensation value (refer to drawing 4) corresponding to distributed gas temperature, the pure-water temperature compensation value (refer to drawing 5) over pure-water temperature, the cell temperature compensation value (refer to drawing 6) over cell temperature, and the cell load correction value (refer to drawing 7) corresponding to a cell load are set up.
[0017] Then, it explains based on the flow chart which shows actuation of a fuel cell 10 to drawing 8 . First, if distributed gas is supplied to the gas supply path 14, the flow rate of said distributed gas which flows this gas supply path 14 will be detected through the distributed gas flow rate detection means 16 (step ST 1). Furthermore, in a step ST 2, if it is judged that distributed gas is flowing to the gas supply path 14 (inside of a step ST 2, YES), it will progress to a step ST 3 and quantity-of-gas-flow correction value will be read.
[0018] The basic pure-water injection quantity Tiw as shown in (b) is set up among drawing 9 , and said basic pure-water injection quantity Tiw is read from the pure-water injection quantity shown in the quantity-of-gas-flow correction value shown in drawing 3 , and drawing 2 B based on the quantity-of-gas-flow correction value read at a step ST 3 (step ST 4).
[0019] Next, the temperature of the distributed gas which flows the gas supply path 14 is detected by the distributed gas temperature detection means 18 (step ST 5). Based on this detected distributed gas temperature, as shown in drawing 4 , the gas-temperature correction value Tgf is read (step ST 6). While pure water is supplied through the pure-water injection means 20, the temperature of this pure water is detected with the pure-water temperature detection means 22 by the distributed gas in the gas supply path 14, and as shown in drawing 5 , the pure-

water temperature compensation value Twf is read into it (a step ST 7, a step ST 8).
[0020] While the distributed gas humidified with pure water is supplied in the body 12 of a fuel cell and oxygen gas or air is supplied to the air pole 32 which constitutes each fuel cell structure 36, hydrogen gas is supplied to the hydrogen pole 34, and a generation of electrical energy is performed.
[0021] The internal temperature of the body 12 of a fuel cell is detected through the interior temperature detection means 26 of a cell (step ST 9), and as shown in drawing 6 , the cell temperature compensation value Tfcf is read based on this detected cell temperature (step ST 10). Furthermore, the cell load of the body 12 of a fuel cell is detected by the cell load detection means 24 (step ST 11), and as shown in drawing 7 , the cell load correction value Tfcff corresponding to the detected cell load is read (step ST 12).
[0022] Subsequently, it progresses to a step ST 13 and the actual pure-water injection quantity Tiwf calculates based on the basic pure-water injection quantity Tiw, the gas-temperature correction value Tgf, the pure-water temperature compensation value Twf, the cell temperature compensation value Tfcf, and the cell load correction value Tfcff. And it is injected by the distributed gas with which the pure water which the pure-water injection means 20 was controlled and was set as the calculated pure-water injection quantity Tiwf flows the gas supply path 14 (step ST 14).
[0023] In this case, with the 1st operation gestalt, based on the distributed gas flow rate detected through the distributed gas flow rate detection means 16, quantity-of-gas-flow correction value is read first, and the basic pure-water injection quantity Tiw is set up corresponding to this quantity-of-gas-flow correction value. Next, the multiplication of the gas-temperature correction value Tgf (accepting the need), the pure-water temperature compensation value Twf, the cell temperature compensation value Tfcf, and the cell load correction value Tfcff is carried out to the basic pure-water injection quantity Tiw, and the actual pure-water injection quantity Tiwf calculates. Then, the pure water set as the pure-water injection quantity Tiwf is injected and humidified by the distributed gas in the gas supply path 14.
[0024] For this reason, time response delay does not occur compared with what the flow rate and temperature of distributed gas are considered, and the amount control of humidification which **(ed) in the actuation situation of the body 12 of a fuel cell is carried out, for example, detects only the internal temperature of this body 12 of a fuel cell. While being able to obtain the optimal cell output from the body 12 of a fuel cell by this, the effectiveness of becoming possible to avoid certainly the fault of an electrolyte membrane 30 drying with the lack of humidification is acquired.
[0025] The effectiveness only by quantity-of-gas-flow correction value is shown in drawing 9 , the effectiveness only by gas-temperature correction value is shown to drawing 10 by here, and the effectiveness only by the pure-water temperature compensation value is further shown in drawing 11 .
[0026] That is, in drawing 9 , based on a quantity of gas flow, quantity-of-gas-flow correction value is set up (refer to (a) among drawing 9), and the basic pure-water

injection quantity Tiw is changed based on this quantity-of-gas-flow correction value (refer to (b) among drawing 9). And when the basic pure-water injection quantity Tiw is injected by distributed gas as pure-water injection quantity Tiwf, the effectiveness that a cell output increases effectively with the increment in a quantity of gas flow is acquired (refer to (c) among drawing 9). Therefore, when the flow rate of distributed gas becomes extensive, it can prevent certainly that an electrolyte membrane 30 dries and a cell output declines.

[0027] In drawing 10 , the gas-temperature correction value Tgf is read corresponding to distributed gas temperature (refer to (a) among drawing 10), and the pure-water injection quantity Tiwf is changed based on this gas-temperature correction value Tgf (refer to (b) among drawing 10). Here, if a lot of pure water is injected when the temperature of distributed gas is low, dew condensation will occur in the gas supply path 14. For this reason, when distributed gas temperature is low, the pure-water injection quantity Tiwf is stopped low. When the temperature of distributed gas becomes high, in order to, prevent lack of the amount of humidification on the other hand, many pure-water injection quantity Tiwf is set up. It becomes possible for this to secure the optimal amount of humidification and to raise a cell output (refer to (c) among drawing 10).

[0028] In drawing 11 , according to pure-water temperature, the pure-water temperature compensation value Twf is read, and the pure-water injection quantity Tiwf is read based on this pure-water temperature compensation value Twf (refer to (a) and (b) among drawing 11). Here, if a lot of pure water is injected when pure-water temperature is low, the distributed gas temperature in the gas supply path 14 will fall, and dew condensation will occur. For this reason, when pure-water temperature is low, the pure-water injection quantity Tiwf is stopped low. On the other hand, when pure-water temperature becomes high, it is easy to generate lack of the amount of humidification, and the pure-water injection quantity Tiwf is made [many] according to this pure-water temperature. It becomes possible to thereby always secure the optimal amount of humidification, and to aim at improvement in a cell output (refer to (c) among drawing 11).

[0029] Drawing 12 is the outline configuration explanatory view of the fuel cell 60 concerning the 2nd operation gestalt of this invention.

[0030] This fuel cell 60 is equipped with the humidification section 62, and this humidification section 60 is attached in the body 64 of a fuel cell in one. In addition, the same reference mark is given to the same component as the fuel cell 10 concerning the 1st operation gestalt, and the detailed explanation is omitted.

[0031] Thus, in the fuel cell 60 constituted, effectiveness, like the optimal amount control of humidification is attained according to the actuation situation of the body 64 of a fuel cell is acquired like the fuel cell 10 concerning the 1st operation gestalt.

[0032]

[Effect of the Invention] As mentioned above, by the fuel cell concerning this invention, and its control approach, since a pure-water injection means is controlled based on the signal from a distributed gas flow rate detection means, a distributed gas temperature detection means (accepting the need), a pure-water temperature detection means, a cell load detection means, and the interior

temperature detection means of a cell, distributed gas is maintainable in the optimal humidification condition. Thereby, it becomes possible to prevent cell performance degradation, desiccation of an electrolyte membrane, etc. effectively.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention relates to the fuel cell which supplies the distributed gas humidified in the body of a fuel cell, and its control approach.

[Translation done.]

PRIOR ART

[Description of the Prior Art] For example, the fuel cell constituted by pinching and carrying out two or more laminatings of the fuel cell structure which opposite-** (ed) the anode lateral electrode and the cathode lateral electrode on both sides of the solid-state polyelectrolyte film with a separator is developed, and it is being put in practical use by various applications.
[0003] By supplying oxidant gas (air) to a cathode lateral electrode, said hydrogen gas ionizes this kind of fuel cell, and it flows the inside of the solid-state polyelectrolyte film, and it is constituted so that electrical energy may be obtained outside by this, while supplying hydrogen gas (fuel gas) to an anode lateral electrode.
[0004] In this case, in the above-mentioned fuel cell, in order to demonstrate an effective generation-of-electrical-energy function, it is necessary to maintain the solid-state polyelectrolyte film in the desired humidification condition. For this reason, the distributed gas humidification equipment which humidifying the distributed gas which is hydrogen gas and oxidant gas is performed, for example, is indicated by JP,7-263010,A is known.
[0005] With the above-mentioned conventional technique, the signal from a load detection means to detect the load of a fuel cell is received. While supplying the amount of the pure water corresponding to the demand moisture content of this fuel cell to the gas supply path which sends distributed gas to said fuel cell In response to the signal from a temperature detection means to detect the internal temperature of said fuel cell, it is constituted so that a heating means formed in said pure-water supply path so that it might become by which the temperature of said pure water spreads the internal temperature of this fuel cell, abbreviation, etc. may be controlled. That is, the load and internal temperature of a fuel cell are detected, and the amount and temperature of pure water which are supplied to a gas supply path are controlled by the above-mentioned conventional technique.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] As mentioned above, by the fuel cell concerning this invention, and its control approach, since a pure-water injection means is controlled based on the signal from a distributed gas flow rate detection means, a distributed gas temperature detection means (accepting the need), a pure-water temperature detection means, a cell load detection means, and the interior temperature detection means of a cell, distributed gas is maintainable in the optimal humidification condition. Thereby, it becomes possible to prevent cell performance degradation, desiccation of an electrolyte membrane, etc. effectively.

[Translation done.]

* NOTICES *

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, with the above-mentioned conventional technique, in order to adjust the humidification condition of distributed gas based on the load and internal temperature of a fuel cell, it is easy to generate response delay in time. Thereby, there are a possibility that the optimal amount of humidification cannot be secured in a transition stage, and a desired cell output cannot be obtained, a possibility that the amount of humidification may be insufficient and an electrolyte membrane may dry, etc., especially. That is, although the flow rate of distributed gas increased, if the amount of the pure water injected by this distributed gas is not changed, the optimal amount of humidification cannot be obtained but the problem that an electrolyte membrane dries and a cell output declines sharply is pointed out.
[0007] This invention can solve this kind of problem, can humidify distributed gas the optimal according to the operating state of a fuel cell, and aims at offering the fuel cell which can obtain a desired cell output certainly, and its control approach.

[Translation done.]

MEANS

[Means for Solving the Problem] In order to solve the aforementioned technical problem, based on the detecting signal from a distributed gas flow rate detection means, a pure-water temperature detection means, a cell load detection means, and the interior temperature detection means of a cell, the humidification condition of the distributed gas supplied to the body of a fuel cell is controlled by the fuel cell concerning this invention, and its control approach by controlling a pure-water injection means. Therefore, time response delay etc. is not caused and optimal distributed gas humidification control according to the actuation situation of a fuel cell is performed. Thereby, the fall of the cell output by the lack of the amount of humidification and desiccation of an electrolyte membrane can be prevented as much as possible, and it becomes possible to always obtain an effective cell output.
[0009] Furthermore, the detecting signal from a distributed gas temperature detection means is added, and a pure-water injection means is controlled. For this reason, while preventing generating of dew condensation in a gas supply path, when distributed gas temperature becomes high, the fall of the cell output by the lack of the amount of humidification of this distributed gas is not caused.
[0010]
[Embodiment of the Invention] Drawing 1 shows the outline block diagram of the fuel cell 10 concerning the 1st operation gestalt of this invention.
[0011] The gas supply path 14 where a fuel cell 10 sends distributed gas (fuel gas/oxidant gas) to the body 12 of a fuel cell, and this body 12 of a fuel cell, A distributed gas flow rate detection means 16 to detect the flow rate of the distributed gas which flows this gas supply path 14, A distributed gas temperature detection means 18 to detect the temperature of said distributed gas which flows said gas supply path 14, A pure-water injection means 20 to supply pure water to said distributed gas which flows said gas supply path 14, A pure-water temperature detection means 22 to detect the temperature of said pure water supplied to this pure-water injection means 20, A cell load detection means 24 to detect the cell load of said body 12 of a fuel cell, an interior temperature detection means 26 of a cell to detect the temperature within said body 12 of a fuel cell, and the control unit that carries out drive control of said fuel cell 10

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the outline configuration explanatory view of the fuel cell concerning the 1st operation gestalt of this invention.
[Drawing 2] Drawing 2 A is the related Fig. of a distributed gas flow rate and the amount of humidification, and drawing 2 B is the related Fig. of a distributed gas flow rate and the pure-water injection quantity.
[Drawing 3] It is the amendment table of a distributed gas flow rate and quantity-of-gas-flow correction value.
[Drawing 4] It is the amendment table of distributed gas temperature and gas-temperature correction value.
[Drawing 5] It is the amendment table of pure-water temperature and a pure-water temperature compensation value.
[Drawing 6] It is the amendment table of cell temperature and a cell temperature compensation value.
[Drawing 7] It is the amendment table of a cell load and cell load correction value.
[Drawing 8] It is a flow chart explaining actuation of said fuel cell.
[Drawing 9] It is an effectiveness explanatory view by quantity-of-gas-flow correction value.
[Drawing 10] It is an effectiveness explanatory view by gas-temperature correction value.
[Drawing 11] It is an effectiveness explanatory view by the pure-water temperature compensation value.
[Drawing 12] It is the outline configuration explanatory view of the fuel cell concerning the 2nd operation gestalt of this invention.
[Description of Notations]
10 60 -- Fuel cell 12 64 -- Body of a fuel cell
14 -- Gas supply path 16 -- Distributed gas flow rate detection means
18 -- Distributed gas temperature detection means 20 -- Pure-water injection means
22 -- Pure-water temperature detection means 24 -- Cell load detection means
26 -- Interior temperature detection means of a cell 28 -- Control unit
30 -- Electrolyte membrane 32 -- Air pole
34 -- Hydrogen pole 36 -- Fuel cell structure
62 -- Humidification section

[Translation done.]

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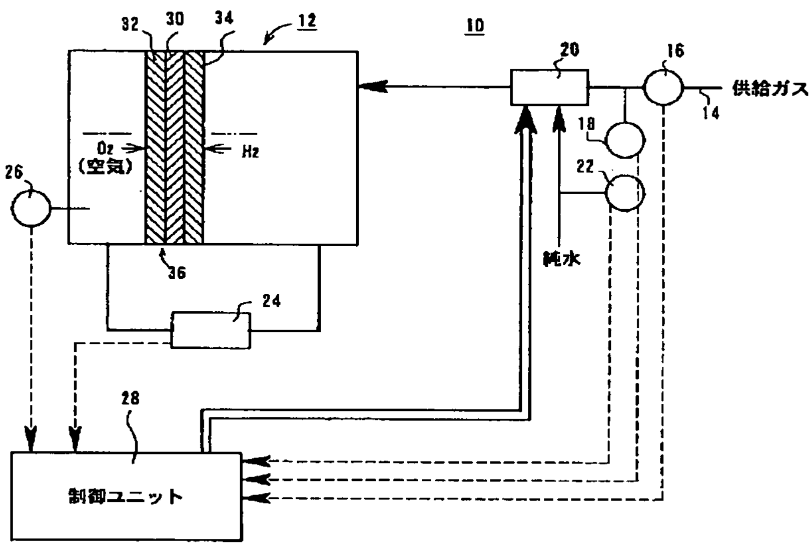
DRAWINGS

[Drawing 1]

FIG. 1



[Drawing 2]

FIG.2A

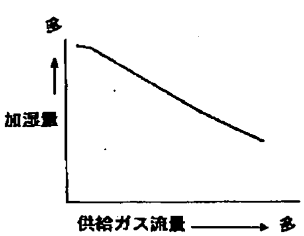
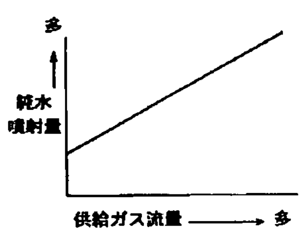
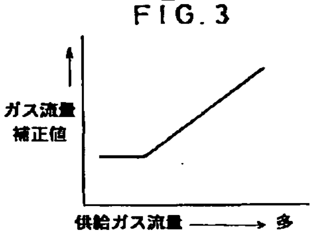


FIG.2B



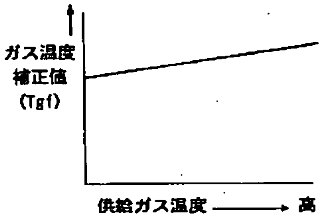
[Drawing 3]

FIG. 3



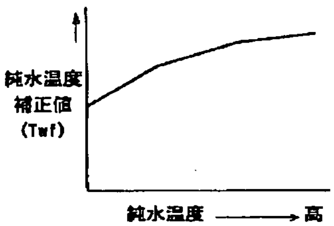
[Drawing 4]

FIG. 4



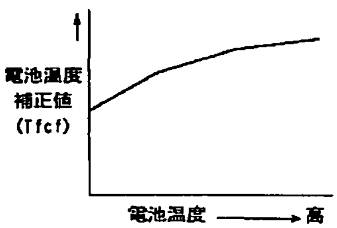
[Drawing 5]

FIG. 5



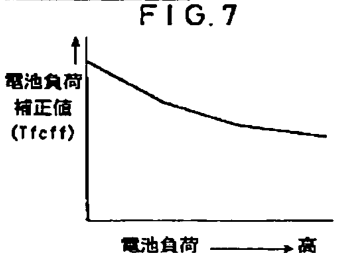
[Drawing 6]

FIG. 6



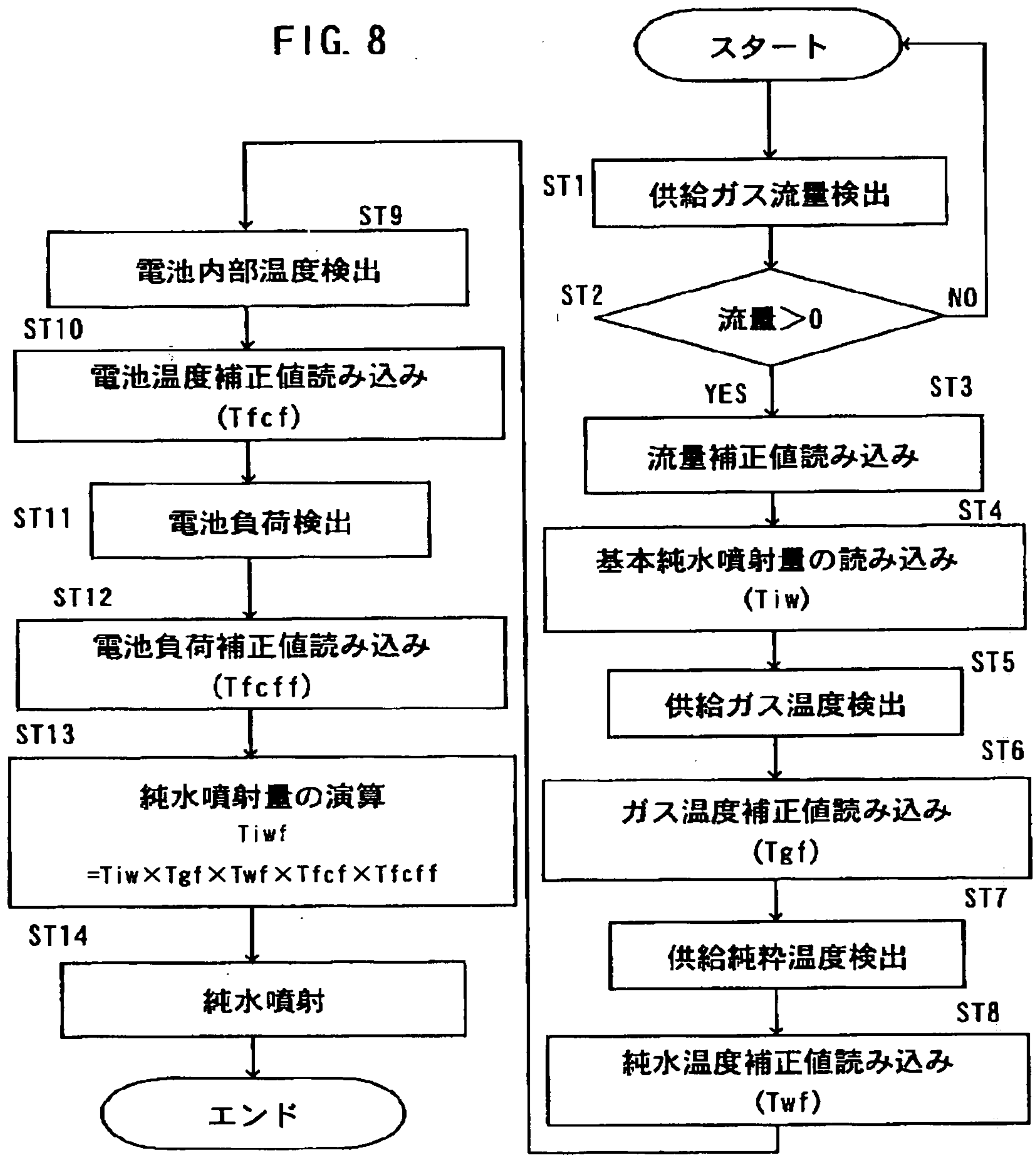
[Drawing 7]

FIG. 7



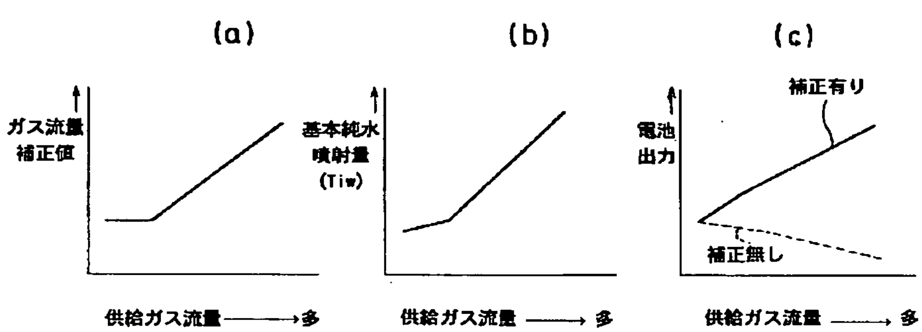
[Drawing 8]

FIG. 8



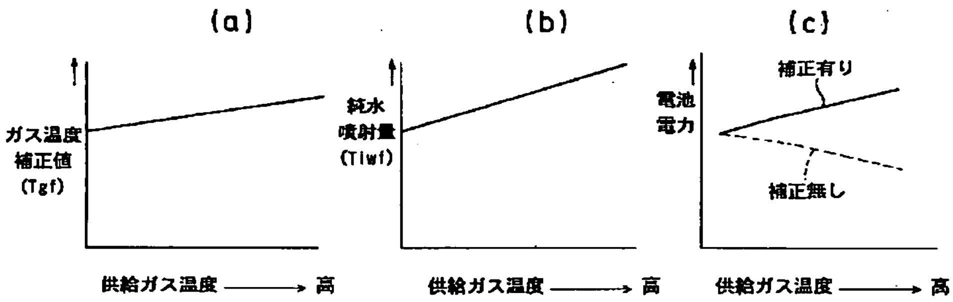
[Drawing 9]

FIG. 9



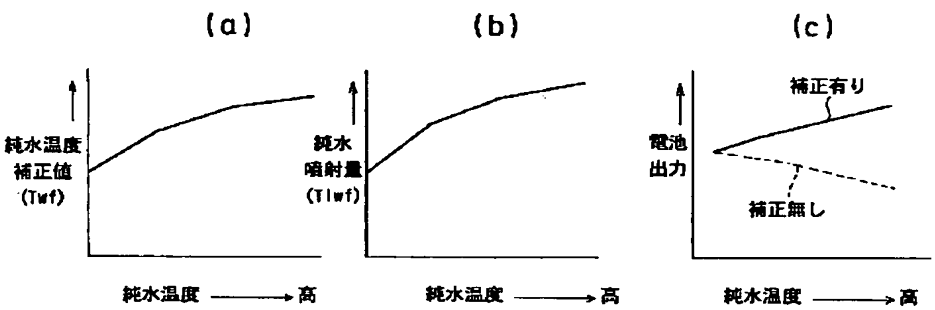
[Drawing 10]

F I G. 10



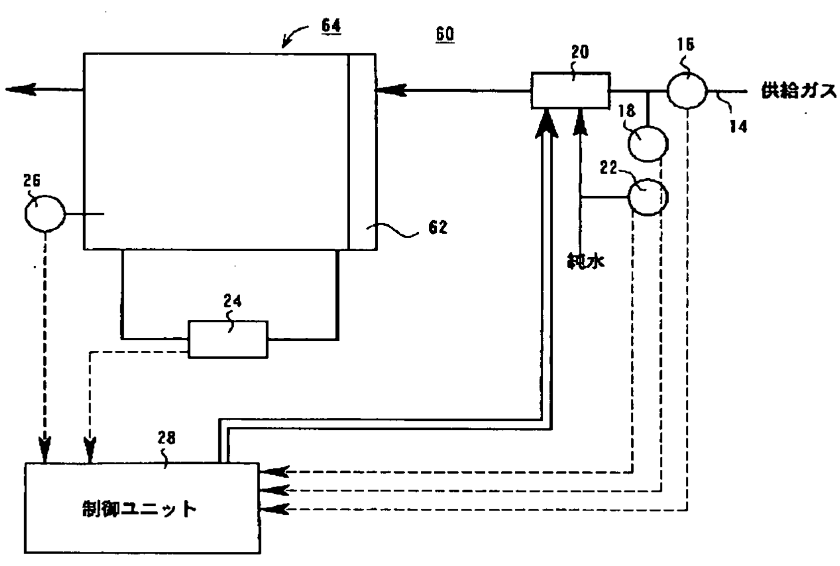
[Drawing 11]

F I G. 11



[Drawing 12]

FIG. 12

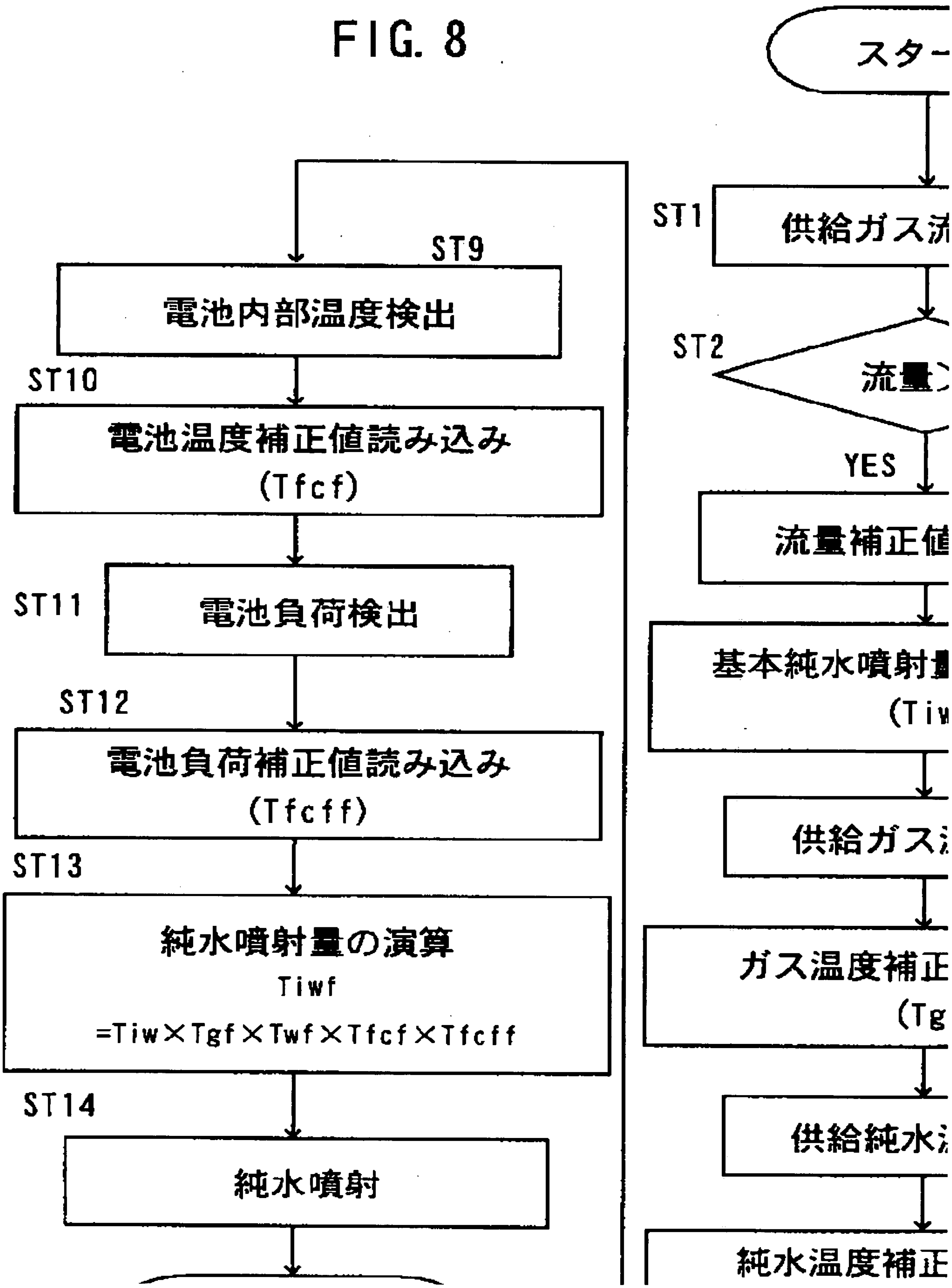


[Translation done.]

WRITTEN AMENDMENT

-- [a procedure revision]
[Filing Date] June 23, Heisei 9
[Procedure amendment 1]
[Document to be Amended] DRAWINGS
[Item(s) to be Amended] drawing 8
[Method of Amendment] Modification
[Proposed Amendment]
[Drawing 8]

FIG. 8


ST9
電池内部温度検出
ST10
電池温度補正値読み込み
(Tfcf)
ST11
電池負荷検出
ST12
電池負荷補正値読み込み
(Tfcff)
ST13
純水噴射量の演算
Tiwf
=Tiw×Tgf×Twf×Tfcf×Tfcff
ST14
純水噴射
スタ
ST1
供給ガス
ST2
流量
YES
流量補正値
基本純水噴射
(Ti
供給ガス
ガス温度補正
(Tg
供給純水
純水温度補正

[Translation done.]

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8/10		8/10	

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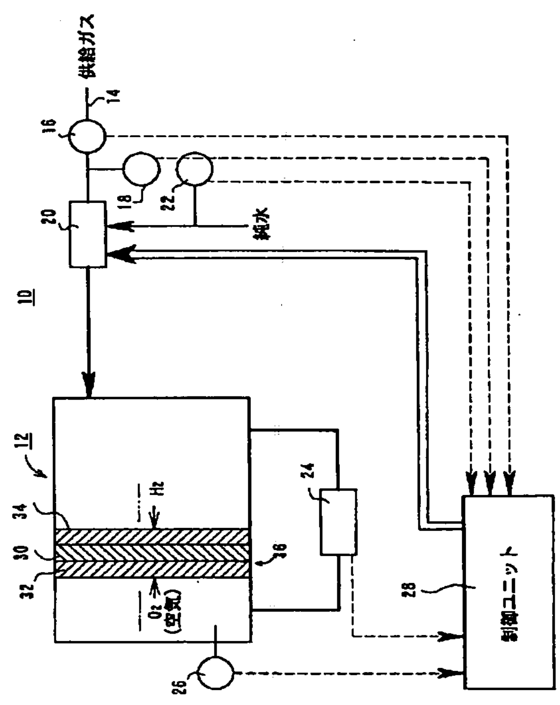
(54)【発明の名称】　燃料電池およびその制御方法

(57)【要約】

【課題】燃料電池の作動状態に応じて供給ガスを最適に加湿することができ、所望の電池出力を確実に得ることを可能にする。

【解決手段】供給ガス流量検出手段１６、供給ガス温度検出手段１８、純水温度検出手段２２、電池負荷検出手段２４および電池内部温度検出手段２６からの信号に基づいて、制御ユニット２８を介してガス供給通路１４の供給ガス中に純水を噴射するための純水噴射手段２０を制御する。

FIG. 1



【特許請求の範囲】
【請求項１】電解質膜を挟んでアノード側電極とカソード側電極が対設された燃料電池構造体を組み込む燃料電池本体と、
前記燃料電池本体に供給ガスを送るためのガス供給通路と、
前記ガス供給通路を流れる前記供給ガスの流量を検出するための供給ガス流量検出手段と、
前記ガス供給通路を流れる前記供給ガスに純水を供給するための純水噴射手段と、
前記純水噴射手段に供給される前記純水の温度を検出するための純水温度検出手段と、
前記燃料電池本体の電池負荷を検出するための電池負荷検出手段と、
前記燃料電池本体内の温度を検出するための電池内部温度検出手段と、
前記供給ガス流量検出手段、前記純水温度検出手段、前記電池負荷検出手段および前記電池内部温度検出手段からの信号に基づいて、前記純水噴射手段を制御するための制御手段と、
を備えることを特徴とする燃料電池。
【請求項２】請求項１記載の燃料電池において、前記ガス供給通路を流れる前記供給ガスの温度を検出するための供給ガス温度検出手段を備え、
前記制御手段は、前記供給ガス温度検出手段からの信号を付加して前記純水噴射手段を制御することを特徴とする燃料電池。
【請求項３】電解質膜を挟んでアノード側電極とカソード側電極が対設された燃料電池構造体を組み込む燃料電池本体に、ガス供給通路を介して送られる供給ガスの流量を検出する工程と、
前記ガス供給通路を流れる前記供給ガスに噴射される純水の温度を検出する工程と、
前記燃料電池本体の電池負荷を検出する工程と、
前記燃料電池本体内の温度を検出する工程と、
前記検出された供給ガスの流量、純水の温度、電池負荷および電池内部温度に基づいて、前記純水噴射手段を制御する工程と、
を有することを特徴とする燃料電池の制御方法。
【請求項４】請求項３記載の制御方法において、前記検出された前記供給ガスの流量に基づいてガス流量補正値を読み込むとともに、前記ガス流量補正値に対応する基本純水噴射量を読み込む工程と、
前記検出された純水の温度、電池負荷および電池内部温度に基づいて、純水温度補正値、電池負荷補正値および電池内部温度補正値を読み込む工程と、
前記基本純水噴射量と前記純水温度補正値、前記電池負荷補正値および前記電池内部温度補正値とに基づいて、前記供給ガスに噴射される純水噴射量を演算する工程と、
を有することを特徴とする燃料電池の制御方法。
【請求項５】請求項４記載の制御方法において、前記ガス供給通路を流れる前記供給ガスの温度を検出し、前記検出された前記供給ガスの温度に基づいてガス温度補正値を読み込むとともに、
前記ガス温度補正値を付加して前記純水噴射量を演算することを特徴とする燃料電池の制御方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、燃料電池本体内に加湿された供給ガスを供給する燃料電池およびその制御方法に関する。
【０００２】
【従来の技術】例えば、固体高分子電解質膜を挟んでアノード側電極とカソード側電極とを対設した燃料電池構造体をセパレータによって挟持して複数積層することにより構成された燃料電池が開発され、種々の用途に実用化されつつある。
【０００３】この種の燃料電池は、例えば、水素ガス（燃料ガス）をアノード側電極に供給するとともに、酸化剤ガス（空気）をカソード側電極に供給することにより、前記水素ガスがイオン化して固体高分子電解質膜内を流れ、これにより外部に電気エネルギが得られるように構成されている。
【０００４】この場合、上記燃料電池では、有効な発電機能を発揮させるために、固体高分子電解質膜を所望の加湿状態に維持する必要がある。このため、水素ガスや酸化剤ガスである供給ガスを加湿することが行われており、例えば、特開平７－２６３０１０号公報に開示されている供給ガス加湿装置が知られている。
【０００５】上記の従来技術では、燃料電池の負荷を検出する負荷検出手段からの信号を受け、この燃料電池の要求水分量に対応する純水の量を、前記燃料電池に供給ガスを送るガス供給通路に供給する一方、前記燃料電池の内部温度を検出する温度検出手段からの信号を受け、前記純水の温度が該燃料電池の内部温度と略等しくなるように前記純水供給通路に設けられた加熱手段を制御するように構成されている。すなわち、上記の従来技術では、燃料電池の負荷および内部温度を検出し、ガス供給通路に供給される純水の量および温度を制御するものである。
【０００６】
【発明が解決しようとする課題】しかしながら、上記の従来技術では、燃料電池の負荷および内部温度に基づいて供給ガスの加湿状態を調整するため、時間的に応答遅れが発生し易い。これにより、特に、過渡期において最適な加湿量を確保することができず、所望の電池出力を得ることができないおそれや、加湿量が不足して電解質膜が乾燥するおそれ等がある。すなわち、供給ガスの流量が多くなったにもかかわらず、この供給ガスに噴射さ

れる純水の量が変更されなければ、最適な加湿量を得ることができず、電解質膜が乾燥して電池出力が大幅に低下するという問題が指摘されている。

【０００７】本発明は、この種の問題を解決するものであり、燃料電池の作動状態に応じて供給ガスを最適に加湿することができ、所望の電池出力を確実に得ることが可能な燃料電池およびその制御方法を提供することを目的とする。

【０００８】

【課題を解決するための手段】前記の課題を解決するために、本発明に係る燃料電池およびその制御方法では、供給ガス流量検出手段、純水温度検出手段、電池負荷検出手段および電池内部温度検出手段からの検出信号に基づいて、純水噴射手段が制御されることにより、燃料電池本体に供給される供給ガスの加湿状態が制御される。従って、時間的な応答遅れ等を惹起することがなく、燃料電池の作動状況に応じた最適な供給ガス加湿制御が行われる。これにより、加湿量不足による電池出力の低下や、電解質膜の乾燥を可及的に阻止することができ、常時、有効な電池出力を得ることが可能になる。

【０００９】さらに、供給ガス温度検出手段からの検出信号を付加して純水噴射手段が制御される。このため、ガス供給通路内での結露の発生を阻止するとともに、供給ガス温度が高くなった際に該供給ガスの加湿量不足による電池出力の低下を惹起することがない。

【００１０】

【発明の実施の形態】図１は、本発明の第１の実施形態に係る燃料電池１０の概略構成図を示す。

【００１１】燃料電池１０は、燃料電池本体１２と、この燃料電池本体１２に供給ガス（燃料ガス／酸化剤ガス）を送るガス供給通路１４と、このガス供給通路１４を流れる供給ガスの流量を検出する供給ガス流量検出手段１６と、前記ガス供給通路１４を流れる前記供給ガスの温度を検出する供給ガス温度検出手段１８と、前記ガス供給通路１４を流れる前記供給ガスに純水を供給する純水噴射手段２０と、この純水噴射手段２０に供給される前記純水の温度を検出する純水温度検出手段２２と、前記燃料電池本体１２の電池負荷を検出する電池負荷検出手段２４と、前記燃料電池本体１２内の温度を検出する電池内部温度検出手段２６と、前記燃料電池１０を駆動制御する制御ユニット（制御手段）２８とを備える。

【００１２】制御ユニット２８は、例えば、ＣＰＵ、ＲＯＭおよびＲＡＭを備えたマイクロコンピュータで構成され、供給ガス流量検出手段１６、供給ガス温度検出手段１８、純水温度検出手段２２、電池負荷検出手段２４および電池内部温度検出手段２６からの信号に基づいて、純水噴射手段２０を制御する機能を有する。

【００１３】燃料電池本体１２は、固体高分子電解質膜３０を挟んで空気極（カソード側電極）３２と、水素極（アノード側電極）３４とを対設した燃料電池構造体３６を備える。この燃料電池構造体３６は、図示しないセパレータを介して複数積層されることにより、燃料電池本体１２が構成される。

【００１４】このように構成される燃料電池１０の動作について、本発明に係る制御方法との関連で以下に説明する。

【００１５】先ず、供給ガスの流量と加湿量との関係が、図２Ａに示されており、供給ガスの流量が多くなるに従って、燃料電池本体１２を構成する電解質膜３０の加湿量が減少する傾向にある。このため、図２Ｂに示すように、供給ガスの流量と純水噴射量との関係が設定される。

【００１６】一方、図３に示すように、供給ガス流量の変化に対応するガス流量補正値の補正テーブルが予め設定されている。その他の補正テーブルとして、供給ガス温度に対応する供給ガス温度補正値（図４参照）、純水温度に対する純水温度補正値（図５参照）、電池温度に対する電池温度補正値（図６参照）、および電池負荷に対応する電池負荷補正値（図７参照）が設定されている。

【００１７】そこで、燃料電池１０の動作を、図8に示すフローチャートに基づいて説明する。先ず、供給ガスがガス供給通路１４に供給されると、このガス供給通路１４を流れる前記供給ガスの流量が、供給ガス流量検出手段１６を介して検出される（ステップＳＴ１）。さらに、ステップＳＴ２において、ガス供給通路１４に供給ガスが流れていると判断されると（ステップＳＴ２中、ＹＥＳ）、ステップＳＴ３に進んでガス流量補正値が読み込まれる。

【００１８】図3に示すガス流量補正値と図２Ｂに示す純水噴射量とから、図９中、（ｂ）に示すような基本純水噴射量Ｔｉｗが設定されており、ステップＳＴ３で読み込まれたガス流量補正値に基づいて、前記基本純水噴射量Ｔｉｗが読み込まれる（ステップＳＴ４）。

【００１９】次に、ガス供給通路１４を流れる供給ガスの温度が、供給ガス温度検出手段１８により検出される（ステップＳＴ５）。この検出された供給ガス温度に基づいて、図4に示すように、ガス温度補正値Ｔｇｆが読み込まれる（ステップＳＴ６）。ガス供給通路１４内の供給ガスには、純水噴射手段２０を介して純水が供給されるとともに、この純水の温度が純水温度検出手段２２により検出され、図5に示すように、純水温度補正値Ｔｗｆが読み込まれる（ステップＳＴ7、ステップＳＴ8）。

【００２０】純水により加湿された供給ガスは、燃料電池本体１２内に供給され、各燃料電池構造体３６を構成する空気極３２に酸素ガスまたは空気が供給される一方、水素極３４に水素ガスが供給され、発電が行われる。

【００２１】燃料電池本体１２の内部温度が電池内部温

度検出手段２６を介して検出され（ステップＳＴ９）、図６に示すように、この検出された電池温度に基づいて、電池温度補正値Ｔｆｃｆが読み込まれる（ステップＳＴ１０）。さらに、燃料電池本体１２の電池負荷が電池負荷検出手段２４により検出され（ステップＳＴ１１）、図７に示すように、検出された電池負荷に対応する電池負荷補正値Ｔｆｃｆｆが読み込まれる（ステップＳＴ１２）。

【００２２】次いで、ステップＳＴ１３に進み、基本純水噴射量Ｔｉｗとガス温度補正値Ｔｇｆ、純水温度補正値Ｔｗｆ、電池温度補正値Ｔｆｃｆおよび電池負荷補正値Ｔｆｃｆｆとに基づいて、実際の純水噴射量Ｔｉｗｆが演算される。そして、純水噴射手段２０が制御されて、演算された純水噴射量Ｔｉｗｆに設定された純水がガス供給通路１４を流れる供給ガスに噴射される（ステップＳＴ１４）。

【００２３】この場合、第１の実施形態では、先ず、供給ガス流量検出手段１６を介して検出された供給ガス流量に基づいてガス流量補正値が読み込まれ、このガス流量補正値に対応して基本純水噴射量Ｔｉｗが設定される。次に、基本純水噴射量Ｔｉｗにガス温度補正値Ｔｇｆ（必要に応じて）、純水温度補正値Ｔｗｆ、電池温度補正値Ｔｆｃｆおよび電池負荷補正値Ｔｆｃｆｆが乗算されて、実際の純水噴射量Ｔｉｗｆが演算される。そこで、純水噴射量Ｔｉｗｆに設定された純水がガス供給通路１４中の供給ガスに噴射されて加湿される。

【００２４】このため、供給ガスの流量および温度を加味して、燃料電池本体１２の作動状況に則した加湿量制御が遂行され、例えば、この燃料電池本体１２の内部温度のみを検出するものに比べ、時間的な応答遅れが発生することがない。これにより、燃料電池本体１２から最適な電池出力を得ることができるとともに、電解質膜３０が加湿不足によって乾燥する等の不具合を確実に回避することが可能になるという効果が得られる。

【００２５】ここで、図９には、ガス流量補正値のみによる効果が示されており、図１０には、ガス温度補正値のみによる効果が示されており、さらに図１１には、純水温度補正値のみによる効果が示されている。

【００２６】すなわち、図９では、ガス流量に基づいてガス流量補正値が設定され（図９中、（ａ）参照）、このガス流量補正値に基づいて基本純水噴射量Ｔｉｗが変更される（図９中、（ｂ）参照）。そして、基本純水噴射量Ｔｉｗが純水噴射量Ｔｉｗｆとして供給ガスに噴射されることにより、ガス流量の増加に伴って電池出力が有効に増加するという効果が得られる（図９中、（ｃ）参照）。従って、供給ガスの流量が大量になったとき、電解質膜３０が乾燥して電池出力が低下することを確実に阻止することができる。

【００２７】図１０では、供給ガス温度に対応してガス温度補正値Ｔｇｆが読み取られ（図１０中、（ａ）参照）、このガス温度補正値Ｔｇｆに基づいて純水噴射量Ｔｉｗｆが変更される（図１０中、（ｂ）参照）。ここで、供給ガスの温度が低いときに大量の純水が噴射されると、ガス供給通路１４内で結露が発生する。このため、供給ガス温度が低い際には、純水噴射量Ｔｉｗｆを低く抑える。一方、供給ガスの温度が高くなったときには、加湿量の不足を防止するため、純水噴射量Ｔｉｗｆを多く設定する。これにより、最適な加湿量を確保して電池出力を向上させることが可能になる（図１０中、（ｃ）参照）。

【００２８】図１１では、純水温度に応じて純水温度補正値Ｔｗｆが読み込まれ、この純水温度補正値Ｔｗｆに基づいて純水噴射量Ｔｉｗｆが読み込まれる（図１１中、（ａ）および（ｂ）参照）。ここで、純水温度が低いときに大量の純水を噴射すると、ガス供給通路１４内の供給ガス温度が低下して結露が発生する。このため、純水温度が低い際には、純水噴射量Ｔｉｗｆを低く抑えている。一方、純水温度が高くなったときには、加湿量の不足が発生し易く、この純水温度に応じて純水噴射量Ｔｉｗｆを多くする。これにより、常時、最適な加湿量を確保して電池出力の向上を図ることが可能になる（図１１中、（ｃ）参照）。

【００２９】図１２は、本発明の第２の実施形態に係る燃料電池６０の概略構成説明図である。

【００３０】この燃料電池６０は、加湿セクション６２を備えており、この加湿セクション６０が燃料電池本体６４に一体的に取着されている。なお、第１の実施形態に係る燃料電池１０と同一の構成要素には同一の参照符号を付して、その詳細な説明は省略する。

【００３１】このように構成される燃料電池６０では、第１の実施形態に係る燃料電池１０と同様に、燃料電池本体６４の作動状況に応じて最適な加湿量制御が可能になる等の効果が得られる。

【００３２】

【発明の効果】以上のように、本発明に係る燃料電池およびその制御方法では、供給ガス流量検出手段、供給ガス温度検出手段（必要に応じて）、純水温度検出手段、電池負荷検出手段および電池内部温度検出手段からの信号に基づいて純水噴射手段が制御されるため、供給ガスを最適な加湿状態に維持することができる。これにより、電池性能の低下や電解質膜の乾燥等を有効に阻止することが可能になる。

【図面の簡単な説明】

【図１】本発明の第１の実施形態に係る燃料電池の概略構成説明図である。

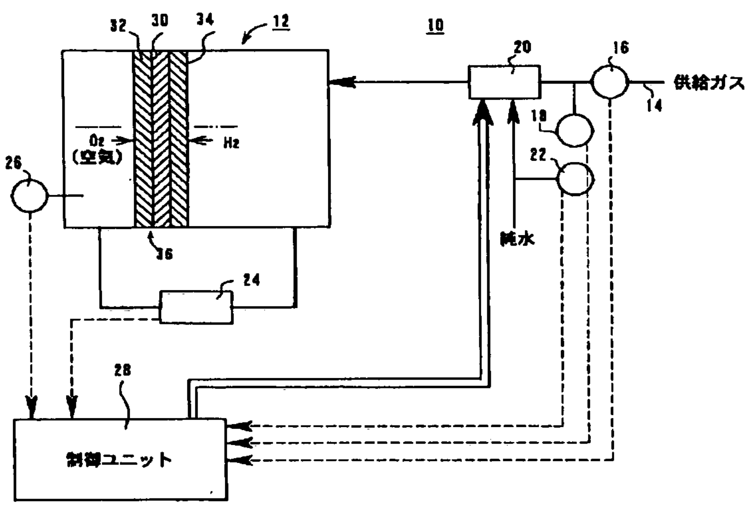
【図２】図２Ａは、供給ガス流量と加湿量との関係図であり、図２Ｂは、供給ガス流量と純水噴射量との関係図である。

【図３】供給ガス流量とガス流量補正値との補正テーブルである。

【図４】供給ガス温度とガス温度補正値との補正テーブルである。
【図５】純水温度と純水温度補正値との補正テーブルである。
【図６】電池温度と電池温度補正値との補正テーブルである。
【図７】電池負荷と電池負荷補正値との補正テーブルである。
【図８】前記燃料電池の動作を説明するフローチャートである。
【図９】ガス流量補正値による効果説明図である。
【図１０】ガス温度補正値による効果説明図である。
【図１１】純水温度補正値による効果説明図である。
【図１２】本発明の第２の実施形態に係る燃料電池の概略構成説明図である。
【符号の説明】
１０、６０…燃料電池　　１２、６４…燃料電池本体
１４…ガス供給通路　　１６…供給ガス流量検出手段
１８…供給ガス温度検出手段　　２０…純水噴射手段
２２…純水温度検出手段　　２４…電池負荷検出手段
２６…電池内部温度検出手段　　２８…制御ユニット
３０…電解質膜　　３２…空気極
３４…水素極　　３６…燃料電池構造体
６２…加湿セクション

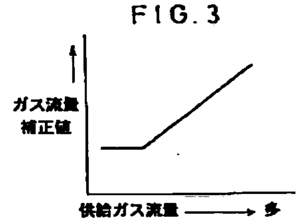
【図１】

FIG. 1



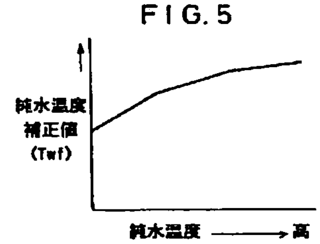
【図３】

FIG. 3



【図５】

FIG. 5



【図２】

FIG. 2A

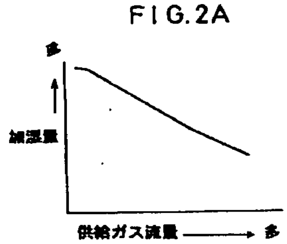
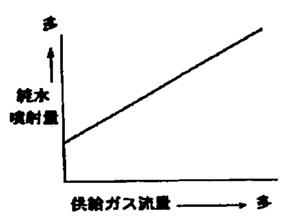
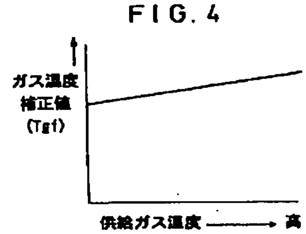


FIG. 2B



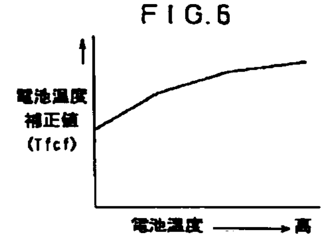
【図４】

FIG. 4



【図６】

FIG. 6



【図７】

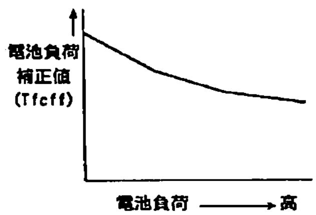


FIG.7
電池負荷補正値 (Tfcff)
電池負荷 → 高

【図８】

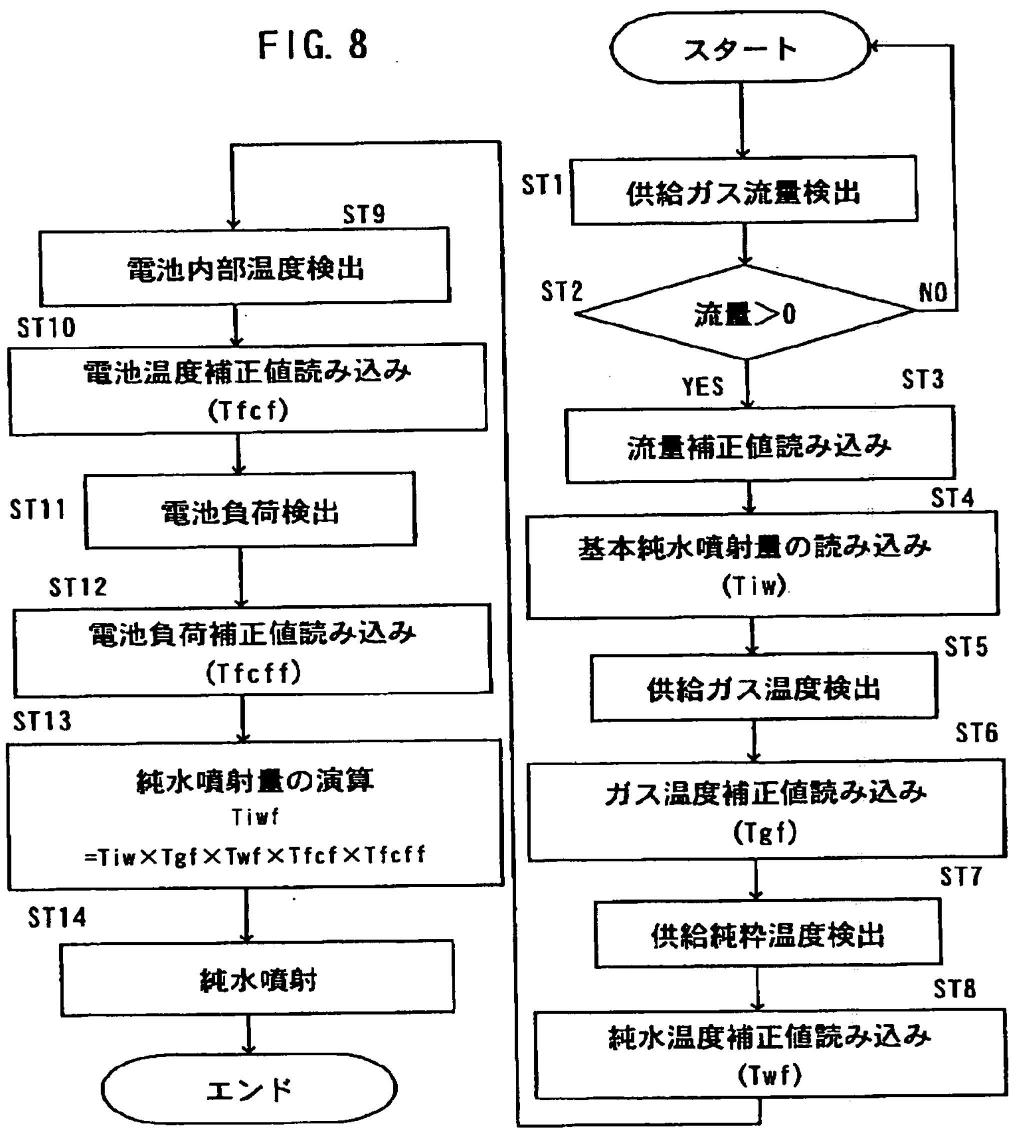
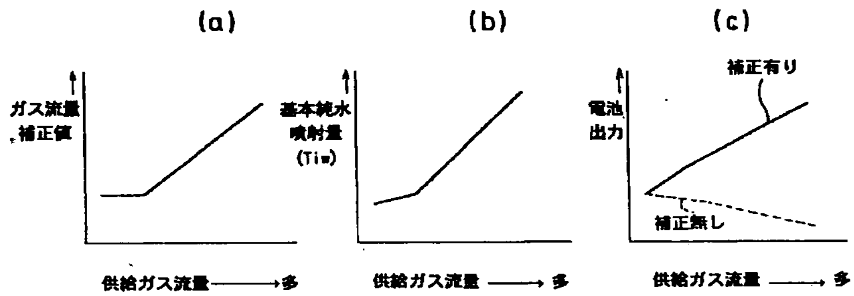


FIG. 8
スタート
ST1 供給ガス流量検出
ST2 流量＞0
NO
YES
ST3 流量補正値読み込み
ST4 基本純水噴射量の読み込み (Tiw)
ST5 供給ガス温度検出
ST6 ガス温度補正値読み込み (Tgf)
ST7 供給純粋温度検出
ST8 純水温度補正値読み込み (Twf)
ST9 電池内部温度検出
ST10 電池温度補正値読み込み (Tfcf)
ST11 電池負荷検出
ST12 電池負荷補正値読み込み (Tfcff)
ST13 純水噴射量の演算 Tiwf =Tiw×Tgf×Twf×Tfcf×Tfcff
ST14 純水噴射
エンド

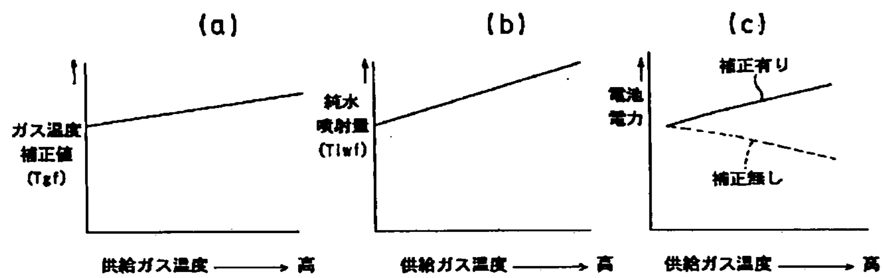
【図９】

FIG. 9



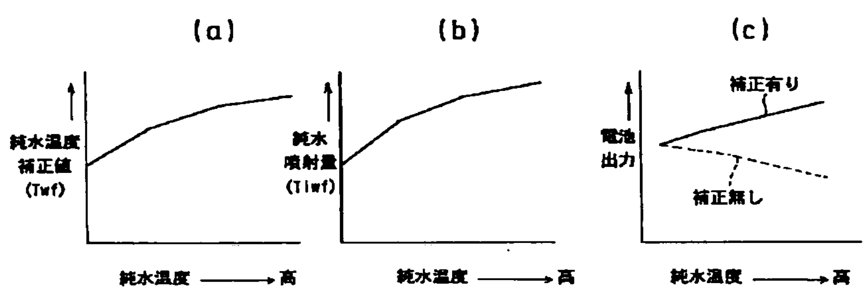
【図１０】

FIG. 10



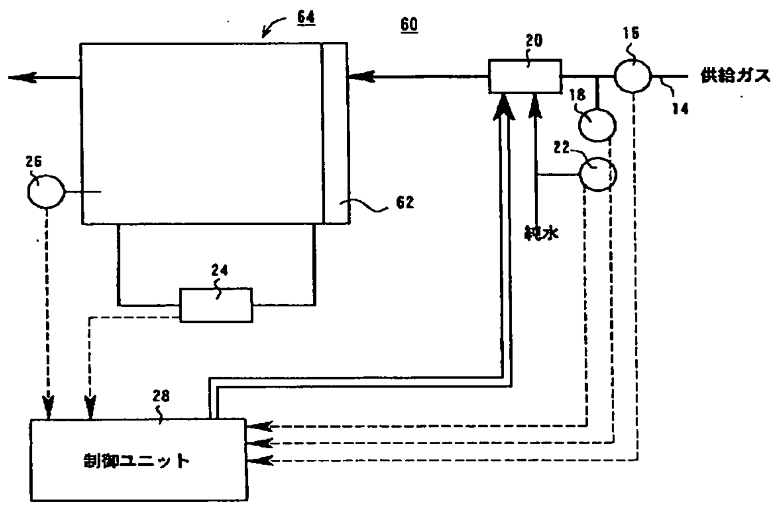
【図１１】

FIG. 11



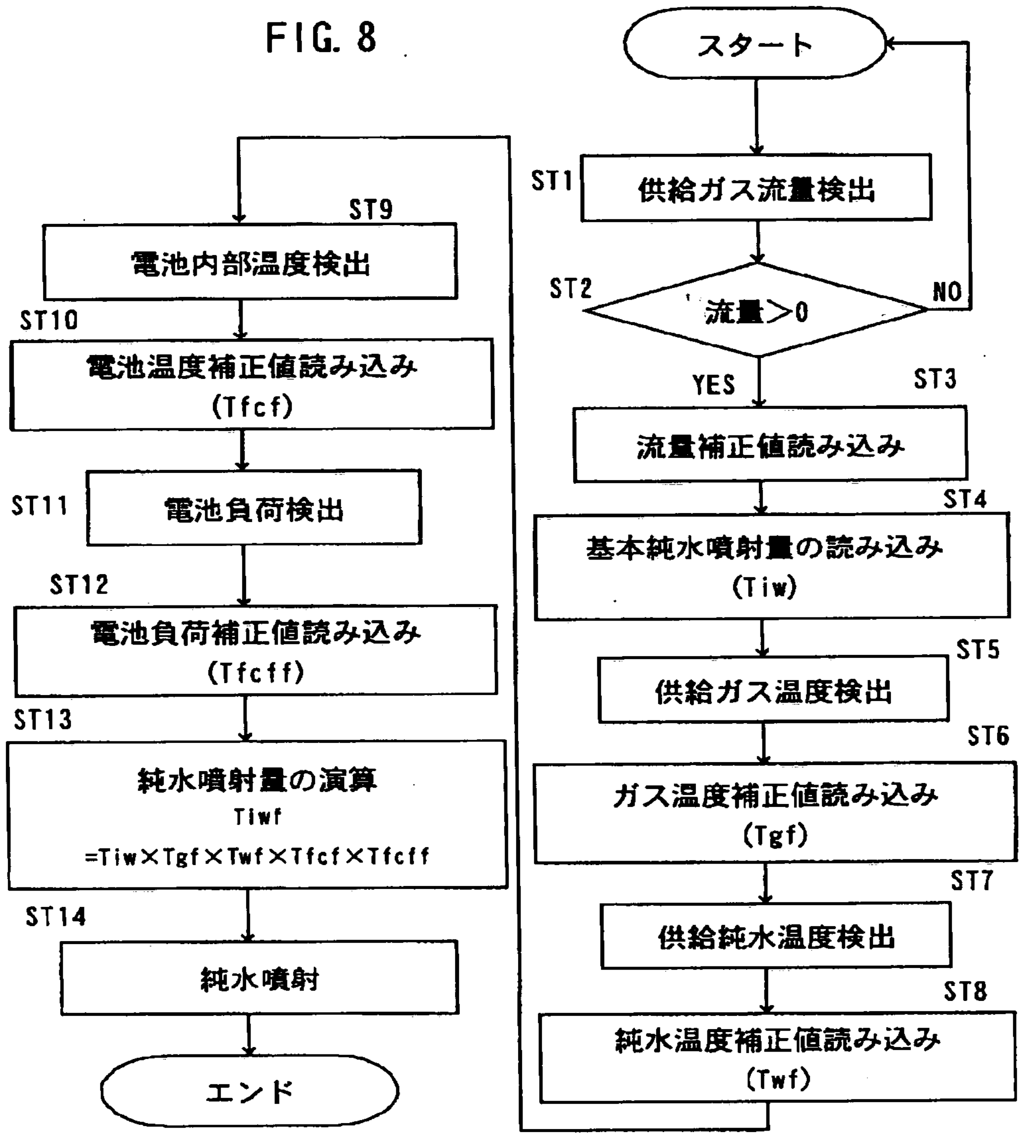
【図１２】

FIG. 12



【手続補正書】
【提出日】平成９年６月２３日
【手続補正１】
【補正対象書類名】図面
【補正対象項目名】図８
【補正方法】変更
【補正内容】
【図８】

FIG. 8



スタート
ST1
供給ガス流量検出
ST2
流量>0
NO
YES
ST3
流量補正値読み込み
ST4
基本純水噴射量の読み込み
(Tiw)
ST5
供給ガス温度検出
ST6
ガス温度補正値読み込み
(Tgf)
ST7
供給純水温度検出
ST8
純水温度補正値読み込み
(Twf)
ST9
電池内部温度検出
ST10
電池温度補正値読み込み
(Tfcf)
ST11
電池負荷検出
ST12
電池負荷補正値読み込み
(Tfcff)
ST13
純水噴射量の演算
Tiwf
=Tiw×Tgf×Twf×Tfcf×Tfcff
ST14
純水噴射
エンド